DOCUMENT RESUME

ED 244 848 SO 015 443

AUTHOR Lougeay, Cheryl
TITLE Interactive Computer Programs for Geographic Education.
PUB DATE Oct 83
NOTE 26p.; Revision of paper presented at the National Council for Geographic Education Conference (Ocho Rios, Jamaica, October 23-28, 1983).
PUB TYPE Reports - Descriptive (141) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Computation; *Computer Assisted Instruction; *Computer Software; Concept Teaching; Demography; Elementary Secondary Education; Geographic Concepts; *Geography Instruction; Higher Education; Human Geography; Interaction; Physical Geography; *Programing
IDENTIFIERS *Interactive Computer Systems

ABSTRACT

Examples of computer programs illustrate how instructors can introduce students to geographic concepts and models while creating a thinking environment in the classroom. The programs are designed to assist students in computational tasks and to provide both graphic and numeric output which will be stimulating. A population pyramid program appropriate for use in a college level human geography course exemplifies poor interactive programming: there are no graphics to reinforce student responses and no opportunity for students to vary input or programming. The second program, suitable for use at any grade level, charts population growth rates of the United States and other countries. It is a good example of interactive programming in that it provides adequate instructions and questions to lead students into the exercise, all instructions and questions are displayed on the screen, error checks are built into the program, and the program allows a wide variety of inputs. The third program, on solar calculations, contains two significant interactive aspects: questions and student responses are displayed and several input options are available. The remaining program, a climatic water balance model for college level courses, demonstrates how instructors can adapt existing programs to increase student interaction. Accompanying figures illustrate video displays for each of the computer programs discussed. (LP)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED244848

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Cheryl Lougeay

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

INTERACTIVE COMPUTER PROGRAMS FOR GEOGRAPHIC EDUCATION

Cheryl Lougeay

Department of Geography

State University of New York College at Geneseo

Geneseo, New York 14454

October, 1983

SO 015 443

INTERACTIVE COMPUTER PROGRAMS FOR GEOGRAPHIC EDUCATION

INTRODUCTION

The interaction between student and computer can be limited to simple drill work, available with many computer assisted instruction (CAI) systems, or extended to significantly enhance lessons. The inclusion of graphics, even simple pictures such as curves and charts, further increases the amount of information that can be communicated to the student in a given period of time. "User-friendly" courseware is a powerful and flexible instructional tool that teachers should incorporate into their geography classes. By capitalizing on the experience of the "Atari generation", the computer can be used to communicate a large amount of information to students in a short period of time and introduce computer novices to basic geographic concepts and models through interactive programs.

Limited, and expensive, commercial courseware is available, but teachers should be encouraged to write their own or modify existing public domain software. This approach has the dual advantages of: 1)cost savings; and 2) being able to make the programs relevant to local examples as well as appropriate geographic concepts.

INTERACTIVE PROGRAMMING CONCEPTS

The purpose of designing highly interactive "user-friendly" programs is to allow the use of this flexible and powerful instructional tool by students and teachers of geography who have no previous computer experience. Locally or commercially furnished software may be utilized, as long as an interactive dialogue with the students is accomplished via a keyboard and video display. Interactive user-friendly software emphasizes ease of use. To run the program on a computer usually requires only a few simple instructions from the user, as the software includes clear and extensive menu selection, computer prompt messages, and help features. Students can immediately begin productive work with a minimum of training.

Computer programs consisting of simple drill work communicate with the student at a terminal or microcomputer monitor by asking questions. The student responds, and the computer then indicates incorrect or correct responses. In more complex programs, the student is supported in the learning task of achieving a correct "answer", and more reinforcing statements may be included. Whatever geographic courseware is chosen, it should demonstrate a question strategy and video display that is appropriate to the lesson.

INTERACTIVE COURSEWARE DESIGNED FOR PHYSICAL AND HUMAN GEOGRAPHIC APPLICATIONS

Examples of interactive programming have been taken from four sample programs, which serve to illustrate how instructors can introduce students to geographic concepts and models by creating a thinking environment in the classroom. Two programs have been created by this author, and two are examples of modified public domain software which have been made interactive for classroom use. The programs are designed to assist students in either complex or repetitive computational tasks, and, additionally, to provide both graphic and numeric output which will be stimulating. The programs have been used in a computer-assisted classroom, and students are often found to be changing the program inputs to "see" the resultant changes in output, thus experimentally investigating the geographic model, the conceptual material, that is involved.

1) Human Geography

Within Human Geography courses at either the secondary or college level, a module on population would be appropriate for the utilization of interactive computer programs to enhance class lessons. Of course students must be introduced to population data sources, such as the *United Nations Demographic Yearbook,* before running programs that utilize these statistics.

Program 1: Population Pyramid

The first program considered is designed for a Burroughs 6800 mainframe computer to produce a population pyramid, which displays the distribution by age and sex of a country's population using bar graphs. Although the output from such a program can be very useful for geography classes, this sample public-domain program has been chosen to illustrate pitfalls in courseware design, and the necessity for modification of programs.

1) The initial screen display provides an example of poor interactive programming (Figure 1) and emphasizes the need for teacher involvement in modifying programs to achieve maximum potential usage. The questions or instructions displayed to the student users give no information on what the program does, and no guidelines on the values to be entered (percentages, totals, etc.). Once the values are entered, there is no opportunity to make changes or to correct errors without re-running the program.

2) Unfortunately, this particular program also provides a poor introduction to the concept of a population pyramid, because it is written only for printer output. There is no video dislay of graphics. This lack means that students face delayed reinforcement, and, most importantly, can not change inputs and immediately view resultant changes in the model.

3) On the population pyramid program output, each bar represents the percentage of the total population that falls into a given age category, and the division by males and females. The United States example is more rectangular than pyramid-shaped because of the large number of older people and a decline in the birth rate (Figure 2). Geographers deal with global problems, so courseware is needed that can display and manipulate population statistics for both developed and developing countries. This author modified the existing program so that it could accommodate a wide variety of plausible inputs. When a variable scale is provided, a population pyramid becomes a valuable tool for comparing countries in terms of their demographics. The distribution of population by age and sex in Mexico, for example, must be displayed with a very broad base due to the large number of young people and the high birth rate (Figure 3).

Instructors must insure adequacy of the scale and applicability of program output for class lessons. After extensive modification, this sample program could be effectively used in Human Geography or Social Studies classes as a basis for the study of such problems as food, pollution, and urbanization.

Program 2: Population Graphs

The second program in this category, a Population Graph program, is a user-friendly interactive program written by this author for the Apple IIE microcomputer as a simple application of histograms (bar graphs) to student work with population statistics. Beyond the demographics of a country's population, however, it specifically introduces time in terms of population growth rates and spatial concepts in terms of population density (the number of humans in relation to the amount of land). The program, written in Applesoft BASIC, is designed to compare growth in the United States and another selected country, displaying annual histograms to illustrate total population of each nation until the population of the selected country equals or exceeds that of the United States. It also gives initial and resultant population density per square kilometer. The model could be used at any grade level to compare other developed or developing countries to the United States in terms of current growth rates. An understanding of the relationships between population growth and density allows class study of policy decision-making relative to issues of development and land use planning.

Selected lines from the program listing along with sample "screen dumps" illustrate several important points relevant to programming of courseware.

1) An interactive environment is provided to lead students into the exercise, with the questions or instructions

designed for video screen readability. The screen display must therefore be carefully designed for the limited 40-column display of the current standard microcomputer that is found in the classroom. All spacing within PRINT statements must be planned to avoid split words or illogical line breaks on the screen. For example, note the difference in the program listing of line 110 compared to what the student views on the screen:

```
110 PRINT "ALL U.S. FIGURES ARE
    BASED ON 1980 DATA:THE POPUL
    ATION IS 226,545,805 AND THE
       GROWTH RATE IS .7% PER YE
    AR."
```

vs.

```
ALL U.S. FIGURES ARE BASED ON 1980 DATA:
THE POPULATION IS 226,545,805 AND THE
GROWTH RATE IS .7% PER YEAR.
```

2) In an interactive environment, the display should, if possible, have both the instruction or question and the student's response simultaneously displayed on the screen. For example:

```
NOW ENTER THE PERCENT POPULATION GROWTH
RATE IN DECIMAL FORMAT.  FOR EXAMPLE, IF
THE GROWTH RATE IS 0.006, THIS MEANS
GROWTH AT THE RATE OF .6% PER YEAR.
ENTER THE RATE AND PRESS <RETURN>.
    ? .2
```

3) A series of error checks are built into the program. First, possible erroneous input, or impossible calculations, are anticipated. The purpose of this sample program is to illustrate positive population growth, so the calculations will not accommodate zero or negative growth rates. An immediate message and program loop allows for reentry of data following the pertinent question.

DO NOT USE NEGATIVE OR ZERO GROWTH
RATES. TRY AGAIN!

Second, if the student wishes to change any responses, a program loop allows reentry of responses or data without re-running the program. For example:

ARE ALL YOUR SELECTIONS O.K.? ENTER
'YES' OR 'NO' AND PRESS <RETURN>.

4) The program accommodates a wide variety of plausible inputs. In this example, the scale of the histogram is determined prior to the video display or printing. Since the 40-column display limits the number of characters per line, the scale of the graph must vary based upon the maximum population figures that are calculated. All too often a program, especially one dealing with population, is written to only accommodate data from developed countries. Since geographers deal with global problems, instructors must be ready to modify programs for use in world regional or human geography classes by providing

variable scaling. In addition, this program limits the display to 100 years of annual histograms and to 500 years of calculations to avoid lengthy pictorial "scrolling" of the display, endless printing, or substantial delays pending completion of calculations. Appropriate warning messages are also displayed.

5) A program can take advantage of special printer capabilities. This program branches to two separate subroutines depending on whether or not printer output is desired (an interactive program gives the student the option of hard copy output). The histogram screen display in this case (Figure 4) utilizes asterisks as the bar graph characters, but more interesting screen as well as printer displays can be designed. The program print option incorporates the creation of special printed characters on the Epson MX80FT Graftrax Plus printer(Lien, 1982,p.14-7).

The final output sample displays growth over time, indicates the scale, and gives both the population and density statistics. In the classroom, geography students can actively change anticipated growth rates to look at the variation in the resultant population growth projections. The program can easily be modified, perhaps making it more complex or adding a variable display of population density. The important step is to involve geography students in an analysis of population statistics, emphasizing both temporal and spatial concepts.

2) Physical Geography

The selected sample interactive programs in Physical Geography are used primarily to accomplish lengthy calculations using large data bases, but also serve to introduce students to energy balance and water balance models. Temporal and spatial variations in the physical environment are emphasized.

Program 1: Solar Calculations

Examples from this first program represent the simplest form of CAI, written by the author for a Burroughs 6800 mainframe computer to assist in time-consuming calculations on a large data base of daily solar radiation values for a particular station, or geographic location. The output from the program provides univariate statistics: the sum, mean, median, and standard deviation. The interactive aspects of the program provide a pattern that instructors can follow to create their own courseware.

1) Questions and student responses are displayed, with reinforcement occurring in the displayed repetition of the responses (Figure 5).

2) The program provides options to: a) allow selection of any period of record, from all years to any subset of recorded solar radiation values (see Figure 5); and b) display or print the data.

This type of program would be useful in college or secondary classes in Physical Geography, Climatology, or Earth

Sciences to statistically compare stations in terms of the amount and variability in receipt of solar radiation in different time periods or from place to place on the earth's surface. Class discussions would include: data collection techniques and instrumentation, as well as regional climatic differences and the energy balance implications for agriculture, housing, and solar energy development.

This simplified example of CAI does not include graphics, which would be useful for visual reinforcement and pattern comparisons. The second program in this section, however, does include a graphic display.

Program 2: Climatic Water Balance Program

The climatic water balance program is a more complex programming example, written for a Burroughs 6800 mainframe computer, that is very conversational and also uses graphs. It is designed for college level use in Physical Geography or Climatology classes to assist in complex calculations and to present a visual display of an important geographic model, the Thornthwaite Water Balance. The program was originally written in FORTRAN IV by L.A. Stone in 1966, revised by David Phillips, and most recently modified by Olga Verbraak, Ray Lougeay, and this author for interactive classroom use. Several illustrations taken from this program will demonstrate how an existing program can be made interactive to both facilitate and encourage student use.

1) The screen prompts for complex data inputs are very

clear and specific. Since directions must be carefully read by the student, cues for input are extensive, followed by a clear signal to begin an entry. For example:

ENTER THE WATER HOLDING CAPACITY OF THE SOIL IN INCHES. BE SURE TO INCLUDE 2 DIGITS BEFORE THE DECIMAL POINT. FOR EXAMPLE : 08.0

ENTER THE WATER HOLDING CAPACITY OF THE SOIL IN INCHES:

Also, students will require preparatory work, during which instructors can introduce many important geographic concepts such as soil water holding capacity, latitude, annual heat index, and temperature and precipitation regimes, all in relationship to a given locations's annual water balance.

2) Calculation delays are conversationally explained:

PLEASE RELAX FOR A FEW MOMENTS WHILE THE COMPUTER DOES ITS THING !!!!!!!

3) Menu choices in this type of program are extensive, both for the printed annual water balance graphs and for the calculated numeric printer and/or screen display. A program loop also allows the student to work with another geographical location or to change inputs for reanalysis of the current station (see Figure 6). For this particular water balance program, an 80 column screen display proves to be too limited for depiction of the annual water balance graphs, so students unfortunately

experience a delay in reinforcement until printer output is retrieved from a central computer facility. Figure 7 illustrates the final printed bar graph of the water balance for an average year in the Central Lakes region of New York.

An interactive water balance program can be used to compare and contrast climates, their energy and moisture regimes. Also, in humid regions, the program can be used by geography students for climatic analysis in problem areas such as land development and anticipated changes in runoff, etc. or to determine drought conditions and the proper use of irrigation water. The preceding samples of user-friendly statements serve as examples that can be incorporated into any program to facilitate its use in a computer-assisted classroom.

CONCLUSION

Interactive computer programs do provide an instructional tool for potential increased productivity and effectiveness in geography class work, especially when graphics are incorporated. Since computers are now becoming widespread in schools at all levels, and it behooves the instructors of geography classes to try such new perspectives to motivate and challenge today's students.

REFERENCES:

Dobson, J. (1983) "Automated Geography." *The Professional Geographer*, Vol. 35, No. 2, pp. 135-142.

Jensen, J.R., Ennerson, F.A., and Hajic, E.J. (1979) "An Interactive Image Processing System for Remote Sensing Education." *Photogrammetric Engineering and Remote Sensing*, Vol. 45, No. 11, pp. 1519-1527.

Lien, D.A. (1982) *EPSON MX Printer Manual*. San Diego: Compusoft Publishing.

Stoltman, J.P. (1983) "Conference on Computer-Assisted Learning in Geography." *Journal of Geography*, Vol. 82, No. 6, pp. 280-281.

Widnall, S. (1983) "Science and the Atari Generation." *Science*, Vol. 221, No. 4611, p. 609.

FIGURE CAPTIONS

Figure 1. Population pyramid program screen display.

Figure 2. United States, 1980, population pyramid.

Figure 3. Mexico, 1980, population pyramid.

Figure 4. Sample output from the Population Graph program.

Figure 5. Solar calculation program initial screen display.

Figure 6. Water Balance program final screen display.

Figure 7. Sample printed bar graph of the annual water balance for an average year in the Central Lakes region of New York.

Enter the title for this pyramid plot.UNITED STATES, 1980

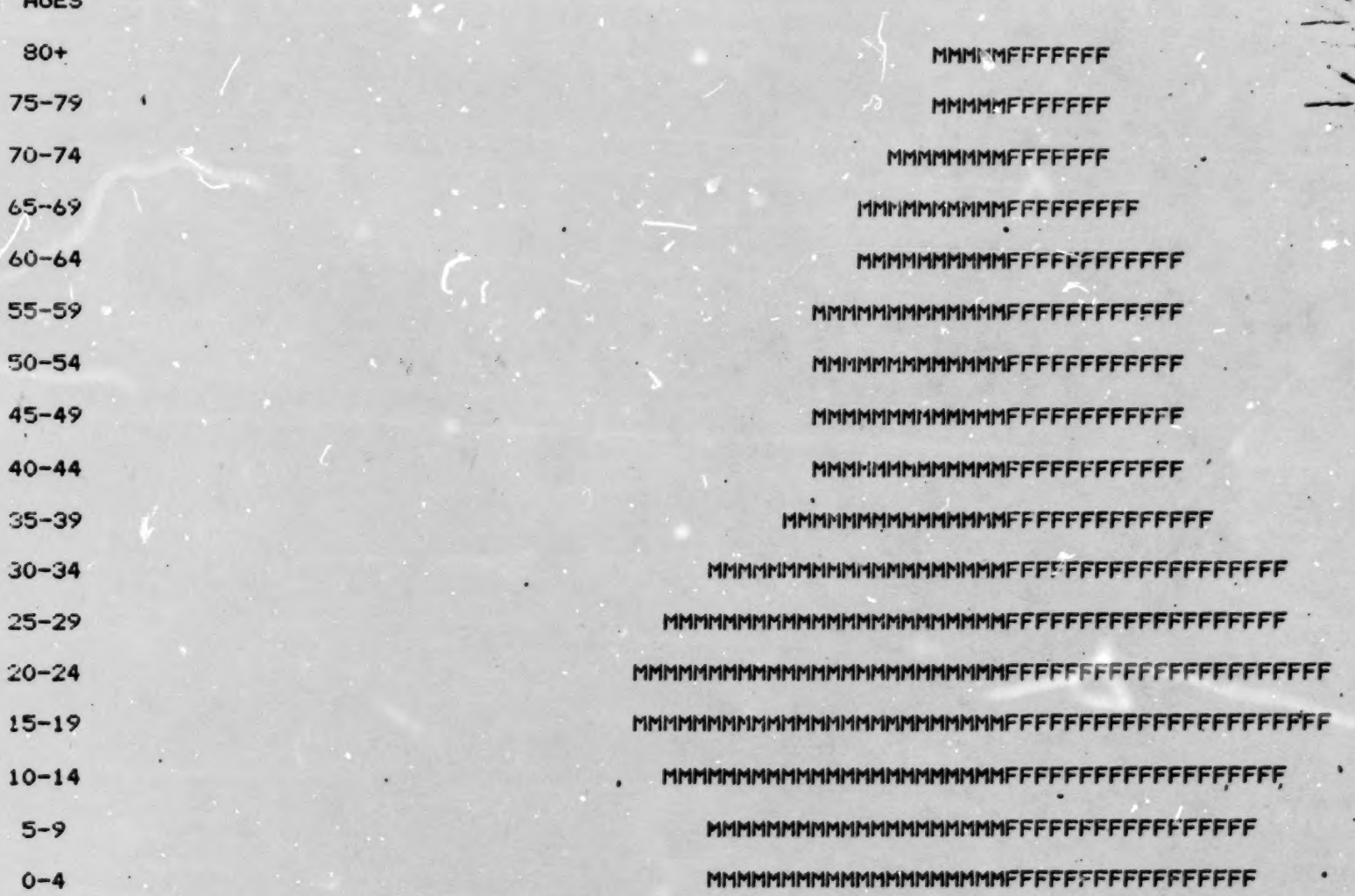
Enter the 17 values for the males,
values should be arranged from the oldest to the youngest categories.
Separate the values with commas.

Enter the 17 values for the females,
values should be arranged from the oldest to the youngest categories.
Separate the values with commas.

Program complete, the plot has been produced.
#ET=14.7 PT=0.9 IO=0.7

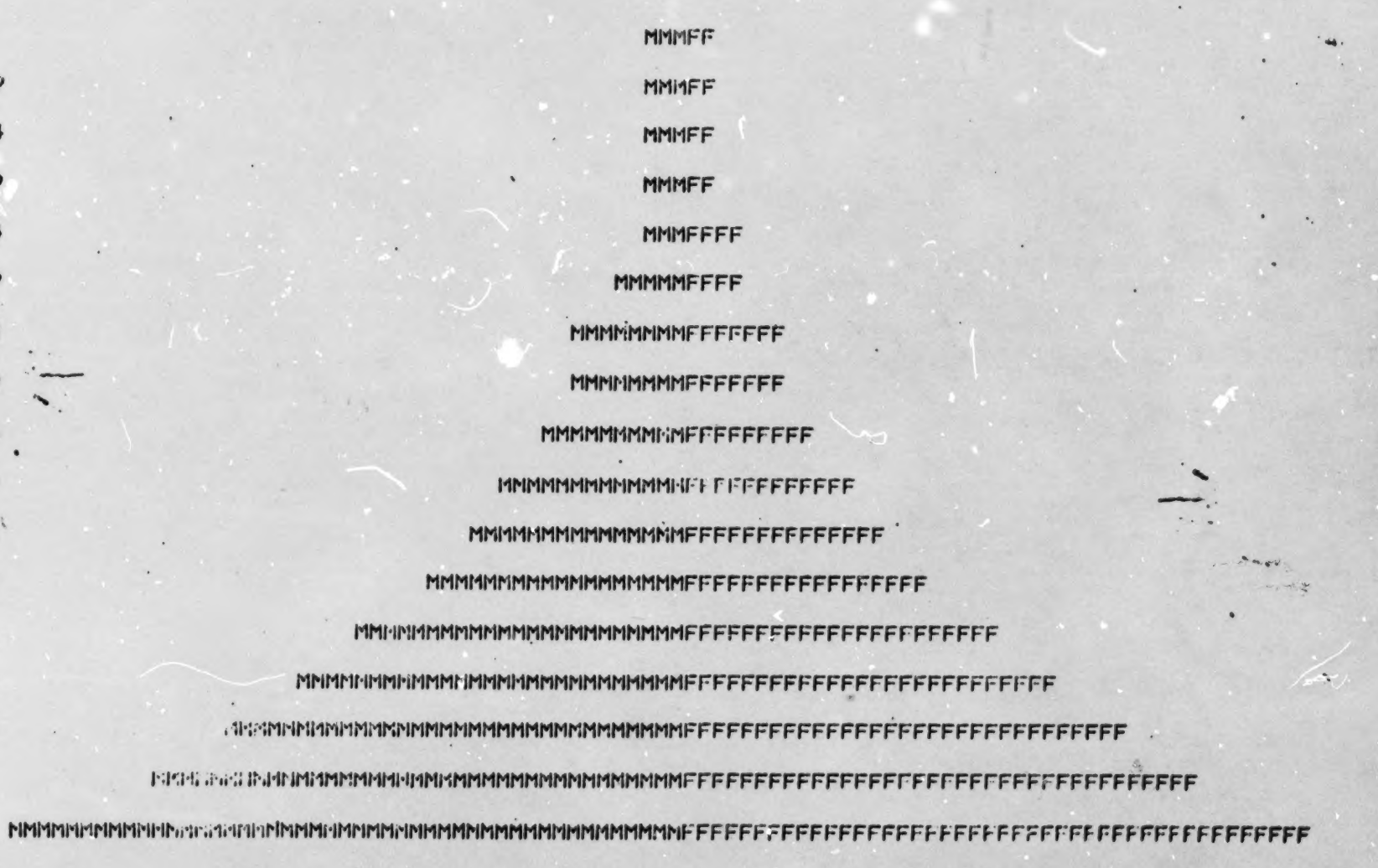
UNITED STATES, 1980

ONE 'M' OR ONE 'F'= .2% OF TOTAL POPULATION
'M'=MALE 'F'=FEMALE



MEXICO

ONE 'M' OR ONE 'F'= .2% OF TOTAL POPULATION
'M'=MALE 'F'=FEMALE



POPULATION GRAPH

```
1981 U.S.**********************
     ANY.************

1982 U.S.***********************
     ANY.***************

1983 U.S.************************
     ANY.******************

1984 U.S.************************
     ANY.**********************

1985 U.S.************************
     ANY.*************************
```

* = 10000000

IN 1985 THE POPULATION OF ANY COUNTRY
WILL BE 248832000.

THE POPULATION DENSITY WILL HAVE
INCREASED FROM 11 TO 28
PEOPLE PER SQUARE KILOMETER.

THE U.S. POPULATION WILL BE 233424224.

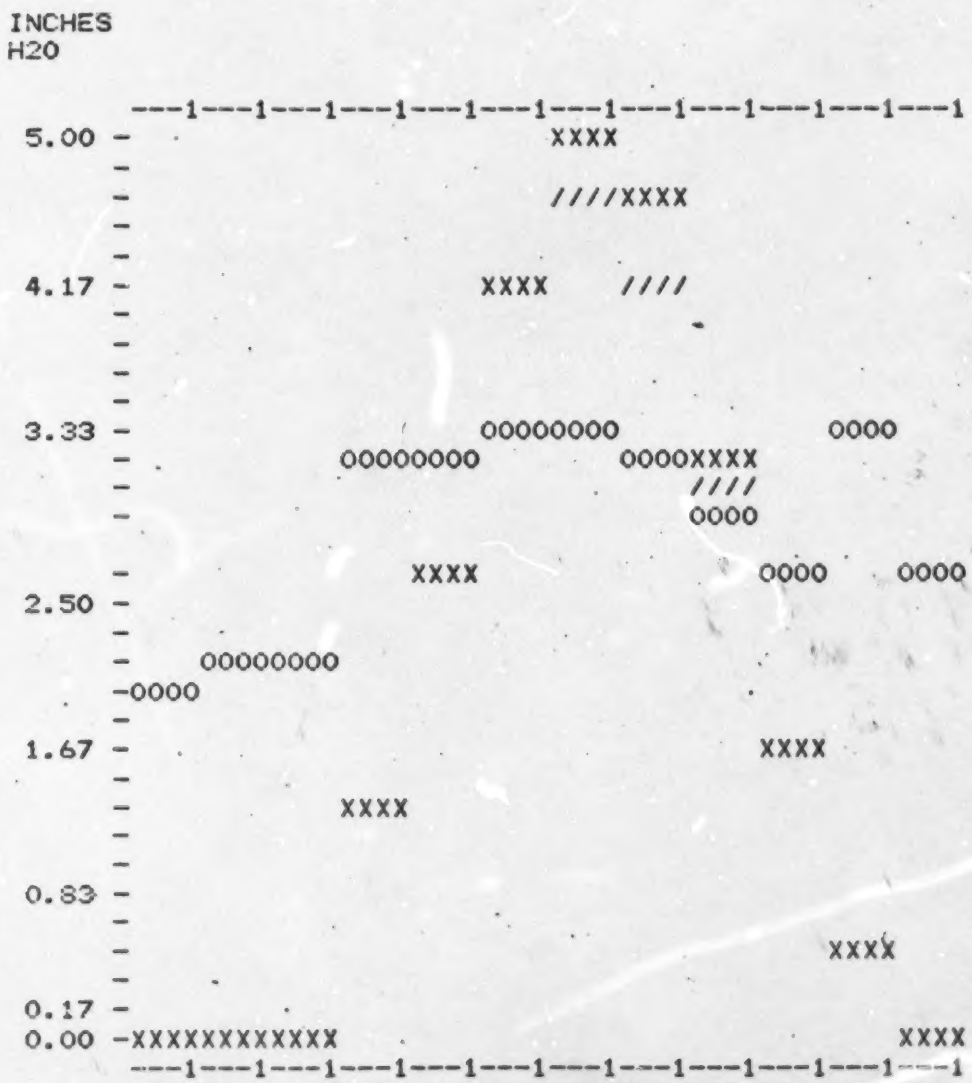
THE POPULATION DENSITY WILL HAVE
INCREASED FROM 24 TO 25
PEOPLE PER SQUARE KILOMETER.

THIS GROWTH TOOK 5 YEARS!

```
FIRST, PLEASE ENTER THE NAME OF THE STATION IN NOT
MORE THAN 30 CHARACTERS.GENESEO, NEW YORK


          GENESEO, NEW YORK

          SOLAR RADIATION ANALYSIS

THIS PROGRAM WILL CALCULATE THE SUM,MEAN,MEDIAN
AND THE STANDARD DEVIATION FOR SOLAR RADIATION AVAILABLE
AT A STATION FOR THE DATES YOU SELECT.  ENTER INFORMATION
EXACTLY AS DIRECTED.


DO YOU WANT ALL THE YEARS OF RECORD?
ANSWER YES OR NO.NO

SPECIFY THE SPECIFIC YEARS BY GIVING THE RANGE:
78,80 WOULD INDICATE 1978 THROUGH 1980 OR 80,80
WOULD INDICATE ONLY THE YEAR OF 1980.81,81

YEARS CHOSEN ARE: 81 THROUGH 81


DO YOU WANT ALL THE MONTHS IN THE YEAR(S)
SELECTED?  ANSWER YES OR NO.NO

SPECIFY THE SPECIFIC MONTHS BY GIVING THE RANGE:
01,05 WOULD INDICATE JAN THROUGH MAY OR 05,05 WOULD
INDICATE ONLY THE MONTH OF MAY.10,10

MONTHS CHOSEN ARE: 10 THROUGH 10


DO YOU WANT ALL THE DAYS IN THE MONTH(S) SELECTED?
ANSWER YES OR NO.YES

DAYS CHOSEN ARE:  ALL DAYS.
```

```
LOOKS LIKES IT'S DONE!
YOU HAVE SEVERAL OPTIONS FOR YOUR RESULTS :
        ENTER A    1  FOR IMMEDIATE DISPLAY ONLY
                   2  FOR PRINTER COPY ONLY
                   3  FOR BOTH OF THE ABOVE OPTIONS

        ENTER YOUR OUTPUT OPTION:


WOULD YOU LIKE THE COMPUTER TO CONSTRUCT
A BAR GRAPH FOR THIS DATA SET?
        ENTER A    1  FOR YES
                   2  FOR NO

        ENTER GRAPH OPTION:


DO YOU HAVE MORE DATA TO ANALYZE?
        ENTER A    1  FOR YES
                   2  FOR NO

        DO YOU HAVE MORE DATA TO ANALYZE:


IS THE NEXT DATA DATA SET FOR A NEW STATION?
        ENTER A    1  FOR YES
                   2  FOR THE SAME STATION

        IS THIS A NEW STATION:
```

CENTRAL LAKES AREA, NEW YORK LAT 42N
SOIL MOISTURE RETENTION = 8.00 INCHES



X = POTENTIAL EVAPOTRANSPIRATION (ADPE)
O = PRECIPITATION (PCPN)

/ = ACTUAL EVAPOTRANSPI RATION (A EV) WHEN A EV < ADPE
2 = TWO COINCIDING VARIABLES
3 = THREE COINCIDING VARIABLES

42.